



U.S. Geological Survey Streamgaging in Montana – Stream Monitoring Methods and Objectives

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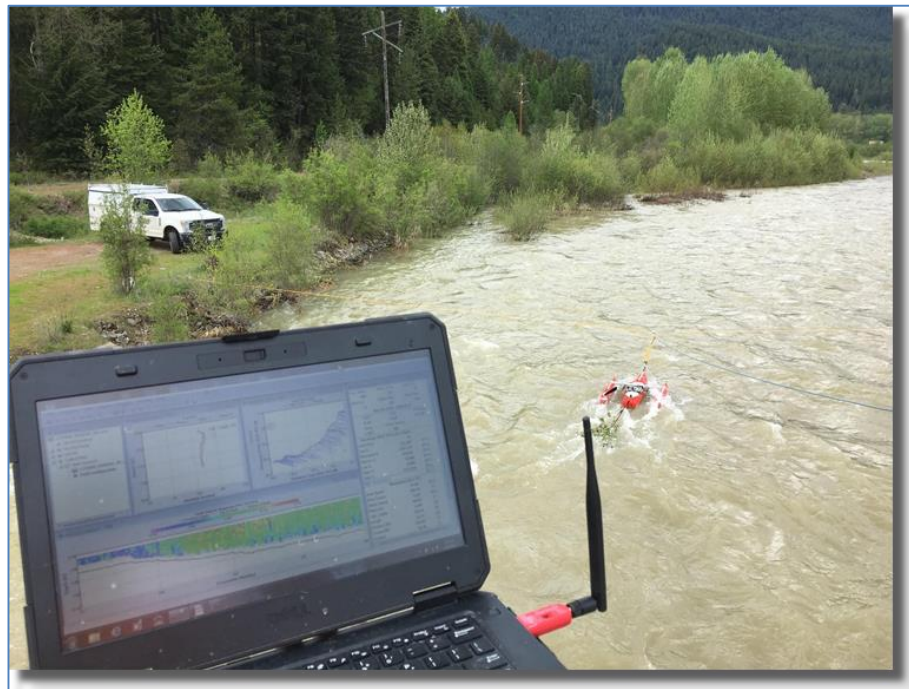
Background

Desired Outcome - Work Group understands:

- Various stream monitoring methods
- Comparison of –
 - Products
 - Objectives
 - Infrastructure

Suggested Topics

- Continuous monitoring
- Periodic monitoring
- Monitoring alternatives



USGS Stream Monitoring

Continuous Discharge

AKA – Streamgage; streamflow-gaging station

Products

- Continuous discharge (streamflow)
 - Continuous stage (gage height)
 - Statistics
 - Discrete discharge measurements
 - Stage-discharge relation (rating)

Objectives (typical)

- NTK stream rate (streamflow; volume / time) at any given time
- NTK streamflow total volume (e.g. acre-feet) over period of time



USGS Stream Monitoring

Continuous Discharge (continued)

AKA – Streamgage; streamflow-gaging station

Infrastructure

- Instrumentation
 - Stage sensor
 - Data logger
 - Telemetry
- Discharge measuring infrastructure
 - Bridge
 - Cableway



USGS Stream Monitoring

Continuous Stage

AKA – Stage-only station

Products

- Continuous stage (gage height)
 - Statistics

Objectives (typical)

- NTK stream stage (gage height) at any given time

Infrastructure

- See: Continuous Discharge
- Exception: No discharge measuring infrastructure (e.g. bridge or cableway)



USGS Stream Monitoring

Annual Maximum

AKA – Crest-stage gage (abbrev. CSG)

Products

- Annual maximum discharge (streamflow)
 - Annual maximum stage (gage height)
 - Stage-discharge relation (rating)
 - Discrete discharge measurements

Objectives (typical)

- NTK annual maximum discharge (streamflow) for flood frequency

Infrastructure

- Crest-stage gage



USGS Stream Monitoring

Discharge Rating Only

AKA – Rating-only site; Staff gage

Products

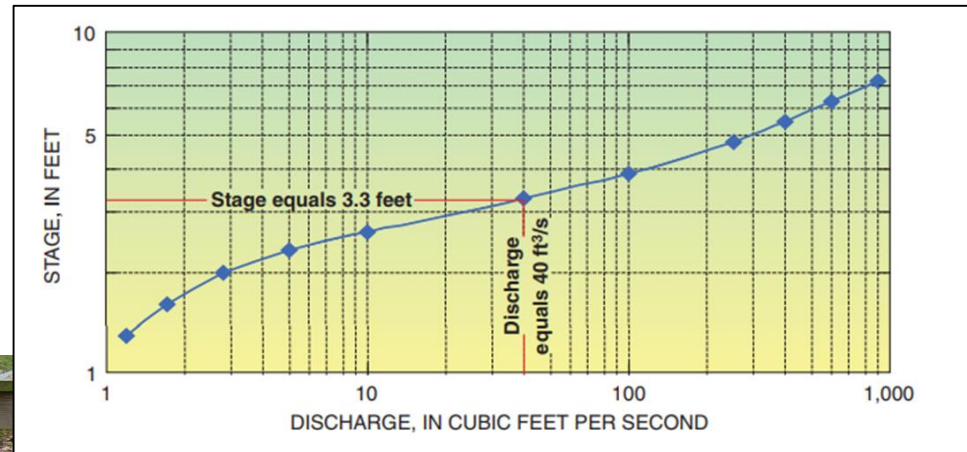
- Stage-discharge relation (rating)
 - Discrete discharge measurements

Objectives (typical)

- NTK stage-discharge relation for determination of stream rate (streamflow) from periodic observations (readings)

Infrastructure

- Staff gage



USGS Stream Monitoring

Periodic Discharge Measurements

Products

- Discrete discharge (streamflow) measurements

Objectives

- NTK periodic stream rate (streamflow)

Infrastructure

- None
- Exception: Discharge measuring infrastructure for non-wadable streamflows



USGS Stream Monitoring

Alternatives

Large-Scale Particle-Image Velocimetry – AKA (LSPIV)

- Estimates of discharge
- Video-based
- Requires channel geometry and discharge coefficient

Statistical Models

- Estimates of streamflow characteristics
- Correlation-based

Deterministic Models

- Estimates of streamflow characteristics
- Hydrologic and hydraulic process-based



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Stream Monitoring Resources

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Water Science Center Home Page

<https://www.usgs.gov/centers/wy-mt-water/>

Montana Current Conditions

<https://waterdata.usgs.gov/mt/nwis/current/?type=flow>

Other USGS Resources

- USGS WaterWatch <https://waterwatch.usgs.gov/>
- USGS WaterNow
<https://www.usgs.gov/mission-areas/water-resources/science/waternow>
- USGS WaterAlert
<https://maps.waterdata.usgs.gov/mapper/wateralert/>



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Stream Monitoring Resources (continued)

Other USGS programs

- [Integrated Water Availability Assessments](#) (IWAA)
- [Next Generation Water Observing Systems](#) (NGWOS)

Selected USGS streamgaging references

- Kenney, T.A., 2010, Levels at gaging stations: U.S. Geological Survey Techniques and Methods 3-A19, 60 p., online at <https://pubs.usgs.gov/tm/tm3A19/>.
- Mueller, D.S., 2016, QRev—Software for computation and quality assurance of acoustic Doppler current profiler moving-boat streamflow measurements—User’s manual for version 2.8: U.S. Geological Survey Open-File Report 2016–1052, 50 p., online at <https://pubs.er.usgs.gov/publication/ofr20161052>.
- Mueller, D.S., Wagner, C.R., Rehmel, M.S., Oberg, K.A., and Rainville, Francois, 2013, Measuring discharge with acoustic Doppler current profilers from a moving boat (ver. 2.0, December 2013): U.S. Geological Survey Techniques and Methods, book 3, chap. A22, 95 p., online at <https://pubs.usgs.gov/tm/3a22/>.
- Rantz, S.E., and others, 1982, Measurement and computation of streamflow: U.S. Geological Survey Water-Supply Paper 2175, vol. 1 and 2, 631 p., online at <https://pubs.usgs.gov/wsp/wsp2175/>.
- Sauer, V.B., 2002, Standards for the analysis and processing of surface-water data and information using electronic methods: U.S. Geological Survey Water Resources Investigations Report 01-4044, 91 p., online at https://pubs.er.usgs.gov/djvu/WRI/wrir_01_4044.pdf.
- Sauer, V.B., and Turnipseed, D.P., 2010, Stage measurement at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A7, 45 p., online at <https://pubs.usgs.gov/tm/tm3-a7/>.
- Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p., online at <https://pubs.usgs.gov/tm/tm3-a8/>.

USGS Stream Monitoring

Question and Answer

